

Polybrominated Diphenyl Ethers (PBDEs)

Identification, Use, Regulation,
Market Changes, & Alternatives

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June 3, 2004



Identification

- Over 175 flame retardant chemicals
- 4 classifications
 - Halogenated Organic (Brominated or Chlorinated)
 - Organophosphorous
 - Nitrogen-based
 - Inorganic

Identification: Brominated Flame Retardants

- Chemically diverse group
- Commonalities: used to flame retard & contain bromine
- Additive or reactive
- PBDE's: additive class of BFR's

Identification: PBDE's

- 209 theoretical congeners, based on number & position of bromine atoms
- Congeners numbered using same system as PCB's (BDE-1 – BDE-209)
- 3 commercial mixtures
 - Penta-BDE
 - Octa-BDE
 - Deca-BDE
- Production of Penta & Octa-BDE will be phased out by end of 2004

Use: Historical perspective

- Past: Products made from more inherently fire-resistant materials, e.g. wood and metal
- Now: Many products from plastic and other oil-based materials that are highly flammable
 - High standards for flame retardancy
 - Additives needed to slow burn rate
- Flame retardants save lives by allowing people to get out of a burning building more quickly

Use: Penta and Octa-BDE

- Penta-BDE: polyurethane foam, epoxy resins, phenol resins, polyesters, and textiles
 - **end products include:** mattresses, seat cushions and other upholstered furniture, and rigid insulation
- Octa-BDE: acrylonitrile butadiene styrene (ABS)
 - **end products include:** computer housings, automobile trim, telephone handsets

Use: Deca-BDE

- Uses: high-impact polystyrene, thermoset and thermoplastic polyesters, polypropylene, crosslinked polyethylene, elastomers, wire and cable insulation of all types, adhesives, coatings and textile coatings
 - **end products include:** housings for televisions, computers, stereos, and other electronics, and upholstery textiles

PBDE Volume Estimates

Total Market Demand by Region in 2001 in Metric Tons
(and by Percent)

PBDE Mixture	Americas	Europe	Asia	Other	Total
Deca	24,500 (44%)	7,600 (14%)	23,000 (41%)	1,050 (2%)	56,100 (100%)
Octa	1,500 (40%)	610 (16%)	1,500 (40%)	180 (5%)	3,790 (100%)
Penta	7,100 (95%)	150 (2%)	150 (2%)	100 (1%)	7,500 (100%)
Total	33,100 (49%)	8,360 (12%)	24,650 (37%)	1,330 (2%)	67,390 (100%)

Source: BSEF, 2001

Regulation: WA State

- WAC 173-303-040 Dangerous Waste Regulations, Persistence Criteria
 - If total concentration of halogenated organic compounds (HOC'S) > 10,000 ppm or 1%, waste designates as Persistent Extremely Hazardous Waste
 - If total concentration of HOC's > 100 ppm or 0.01%, waste designates as Persistent Dangerous Waste.

Regulation: Other States

- CA ('08), HI ('06), ME ('06)- will ban use of Penta and Octa-BDE
- ME- Annual review of Deca-BDE toxicology & available alternatives required by legislature

Regulation: US

- Toxics Release Inventory- Deca-BDE
- Under the Toxic Substances Control Act (TSCA), EPA can require testing of certain chemicals
- Testing under the Voluntary Children's Chemical Evaluation Program (VCCEP)
- Included in High Production Volume (HPV) Chemical Program
- HAPS: PBDEs included in the list of compounds comprising Polycyclic Organic Matter in April 2002

Regulation: EU & RoHS

- Restriction on Hazardous Substances (RoHS) in electrical and electronic equipment, passed 1/27/03
- Bans PBDE's in electronic and electrical equipment as of 7/1/06
- Provides for risk assessment of Deca-BDE

Regulation: EU & RoHS

- Deca-BDE risk assessment concluded 5/04
 - Manufacturers offered to achieve voluntary emission reductions at production sites
 - No additional legislative controls necessary
 - Extra study on neurotoxicological effects likely to be commissioned, completed by 12/06
 - Biomonitoring program will track levels of Deca-BDE in environment and humans
- Proposal to exempt Deca-BDE from RoHS expected

Regulation

- China: Finalizing draft regulation based on RoHS
- Sweden: Planning to propose ban on Deca-BDE
- South Korea: Considering limits on PBDE's- ?
- Japan: Voluntary phase-out of Penta and Octa-BDE

Market Changes: Eco-Labels

- Eco-Labels: Voluntary programs that set standards for manufacturing processes and product design for specific categories of products
- Number of eco-label programs have requirements for PBDE's in consumer electronics, especially computer equipment

Market Changes: Green Procurement and Electronics

- Some governments and corporations issuing RFP's for electronics with restrictions on PBDE's
 - Seattle, WA- disclose use of HOC's
 - Denver, CO- must have eco-label
 - Massachusetts- no BFR's

Phase-Out and Alternatives

- Many electronics manufacturers have or are in process of phasing out PBDE's, either entirely or in some products: Apple, Brother, Canon, Compaq, Daikin, Dell, Ericsson, Matsushita, Minolta, NEC, Sanyo, Sharp, Sony, Xerox
- Foam manufacturers compelled to phase-out Penta-BDE, due to end of production

Phase-Out and Alternatives

- Large data gaps with regard to environmental and human health and alternatives
- EPA Design for the Environment Program conducting literature survey on alternatives
 - Penta-BDE- working primarily with furniture manufacturers & chemical industry
 - Deca-BDE- for application in coated wire and cable industry